Annalen der Physik (Leipzig) 2004 vol.13 N3, pages 149-174

Unconventional superconductivity and magnetism in Sr2RuO 4 and related materials

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Abstract

We review the normal and superconducting state properties of the unconventional triplet superconductor Sr2RuO4 with an emphasis on the analysis of the magnetic susceptibility and the role played by strong electronic correlations. In particular, we show that the magnetic activity arises from the itinerant electrons in the Ru d-orbitals and a strong magnetic anisotropy occurs ($\chi_{+-} < \chi_{zz}$) due to spin-orbit coupling. The latter results mainly from different values of the g-factor for the transverse and longitudinal components of the spin susceptibility (i.e. the matrix elements differ). Most importantly, this anisotropy and the presence of incommensurate antiferromagnetic and ferromagnetic fluctuations have strong consequences for the symmetry of the superconducting order parameter. In particular, reviewing spin fluctuation-induced Cooper-pairing scenario in application to Sr 2RuO4 we show how p-wave Cooper-pairing with line nodes between neighboring RuO2-planes may occur. We also discuss the open issues in Sr2RuO4 like the influence of magnetic and non-magnetic impurities on the superconducting and normal state of Sr 2RuO4. It is clear that the physics of triplet superconductivity in Sr2RuO4 is still far from being understood completely and remains to be analyzed more in more detail. It is of interest to apply the theory also to superconductivity in heavy-fermion systems exhibiting spin fluctuations.

Keywords

Spin fluctuations, Strong electronic correlations, Unconventional triplet superconductivity